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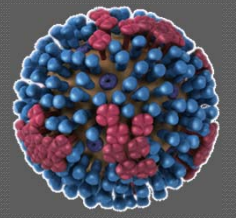
EXPOSURE TO INFLUENZA AEROSOLS DURING ROUTINE PATIENT CARE



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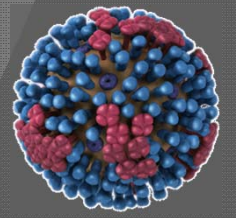
Background

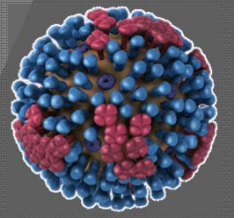
- Millions have lost their lives to influenza in pandemics
- Epidemics of varying severity occur worldwide each year.
- Influenza A H7N9 is the latest threat
- Current Recommendations (CDC, WHO):
  - Droplet/Contact Precautions since Influenza transmission has been thought to primarily occur by large-particle respiratory droplets.
  - Only during aerosol-generating procedures such as bronchoscopies are fit-tested respirators required.
  - Influenza A H7N9 – airborne plus contact plus eye-protection



Objective

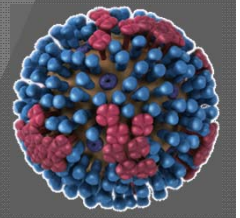
- This study examines:
  - the spatial distribution of influenza aerosols generated by symptomatic patients in a healthcare setting

- and identifies:
  - clinical features associated with high levels of influenza release.



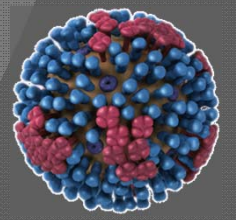
Setting

- 2010/11 Influenza Season
- WFBMC is an 885 bed tertiary care teaching hospital
- Mandatory vaccination policy for all healthcare providers (HCPs) since 2009.
- During the study season 247 influenza positive patients identified (115 inpatients, 67 clinic patients, 65 ED patients)
- All test rooms: Turbulent airflow (6 air changes/hour); ANSI/ASHRAE 52.2 compliant endfilters (MERV 15)



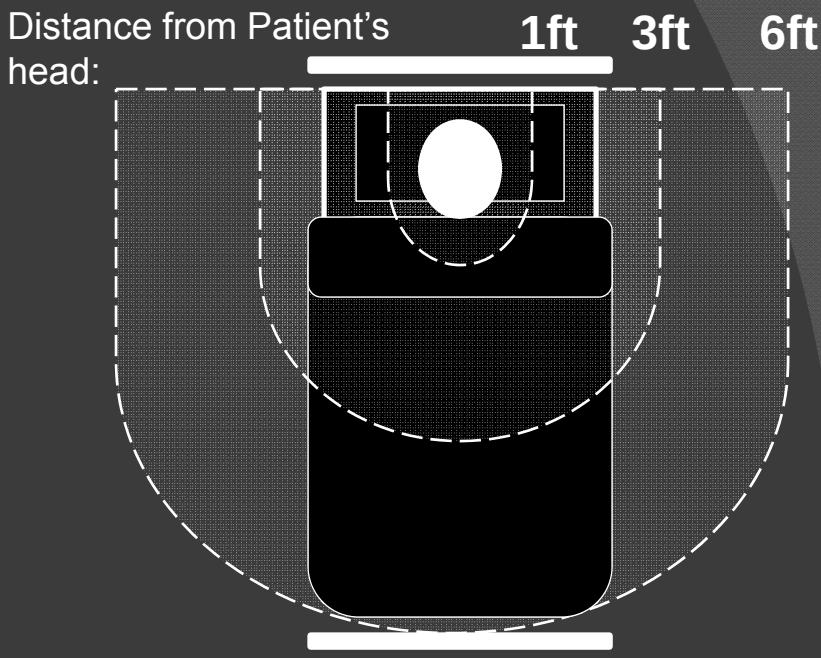
Methods

- Patients >2 years of age admitted to the ED or an inpatient care unit with ILI.
  (documented fever [≥37.8° C] or patient-reported in the past 12 hours, cough/sore throat, and suspected influenza)
- Demographics, medical/vaccination history, and treatments recorded.
- Nasopharyngeal swabs obtained from each subject.
  (bedside rapid testing [BinaxNOW Influenza A&B] and inoculation [BD Diagnostics] for rRT-CR analysis; air samples not obtained from participants negative for influenza by rapid testing)

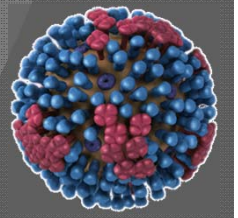


Methods

- Air Sampling
  - Six-stage Andersen air-samplers (AS)
  - 20 minute runs
  - rRT-PCR testing
  - No face/oxygen masks on participants
  - No aerosol generating procedures performed



- Measures of Illness
  - Symptoms at admission (Likert scale), and days sick
  - Severity of illness and interference with daily life by ILI (VAS)
  - Patient's coughs/sneezes during air sampling



Methods

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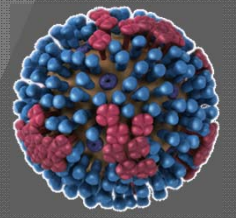
- Statistical Analysis
  - Categorical variables - chi square and fisher exact tests
  - Continuous variables - t-tests and Wilcoxon rank sum tests
  - Spatial aerosol distribution - generalized estimating equation model for Poisson distribution with log link function
  - Significance level was set at 0.05



Results

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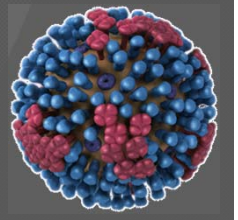
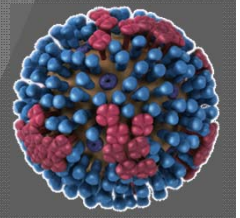
- Influenza Positivity
  - Ninety-four patients with ILI symptoms enrolled
  - Sixty-one (65%) positive for influenza, 31 carrying influenza A and 30 influenza B
  - Thirty-five subjects underwent air sampling as inpatients, and 26 in the ED
  - Aerosolized influenza detected in 26 (43%) subjects (13 inpatients, 13 ED patients)
  - Rapid testing matched rRT-PCR results of nasopharyngeal and air samples



Results

- Patient Characteristics
  - Influenza-negative vs. positive patients:
    - younger
    - receiving less antiviral therapy
    - more likely enrolled in the ED
  - No significant differences between emitters and non-emitters
- Influenza specific variables during air sampling
  - Emitters:
    - higher nasopharyngeal viral loads
    - Increased virus release by coughing and sneezing among patients with increased nasopharyngeal viral load only
    - higher severity of illness and interference with daily lives (ED only)
  - Three ED patients admitted to the hospital (sickle cell syndrome (1x), sickle cell with asthma (1x), and foot injury (1x) - none were emitters)



Results

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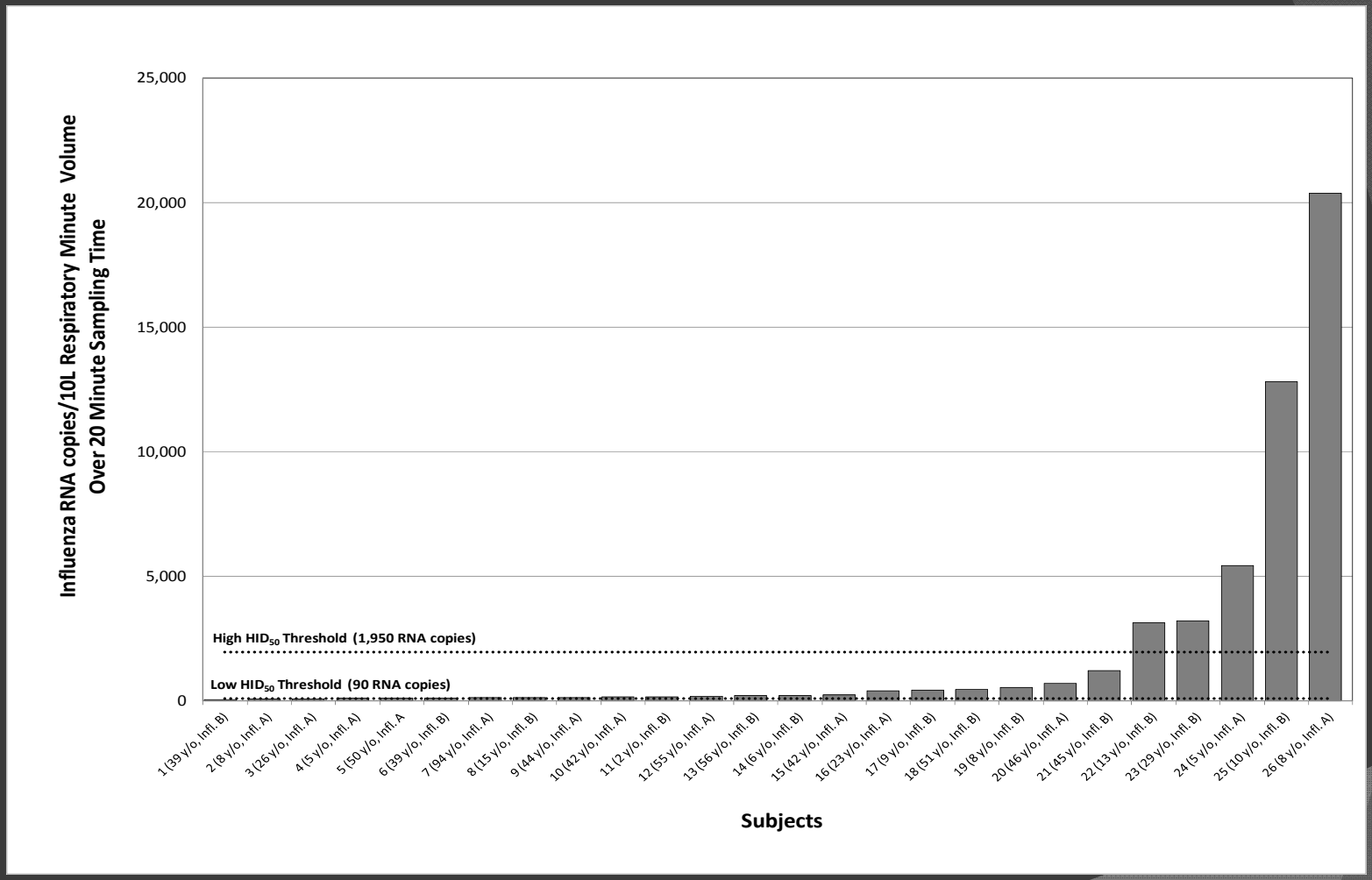
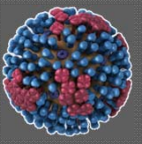


Total Influenza Aerosol Concentrations Emitted by Individual Subjects



Results

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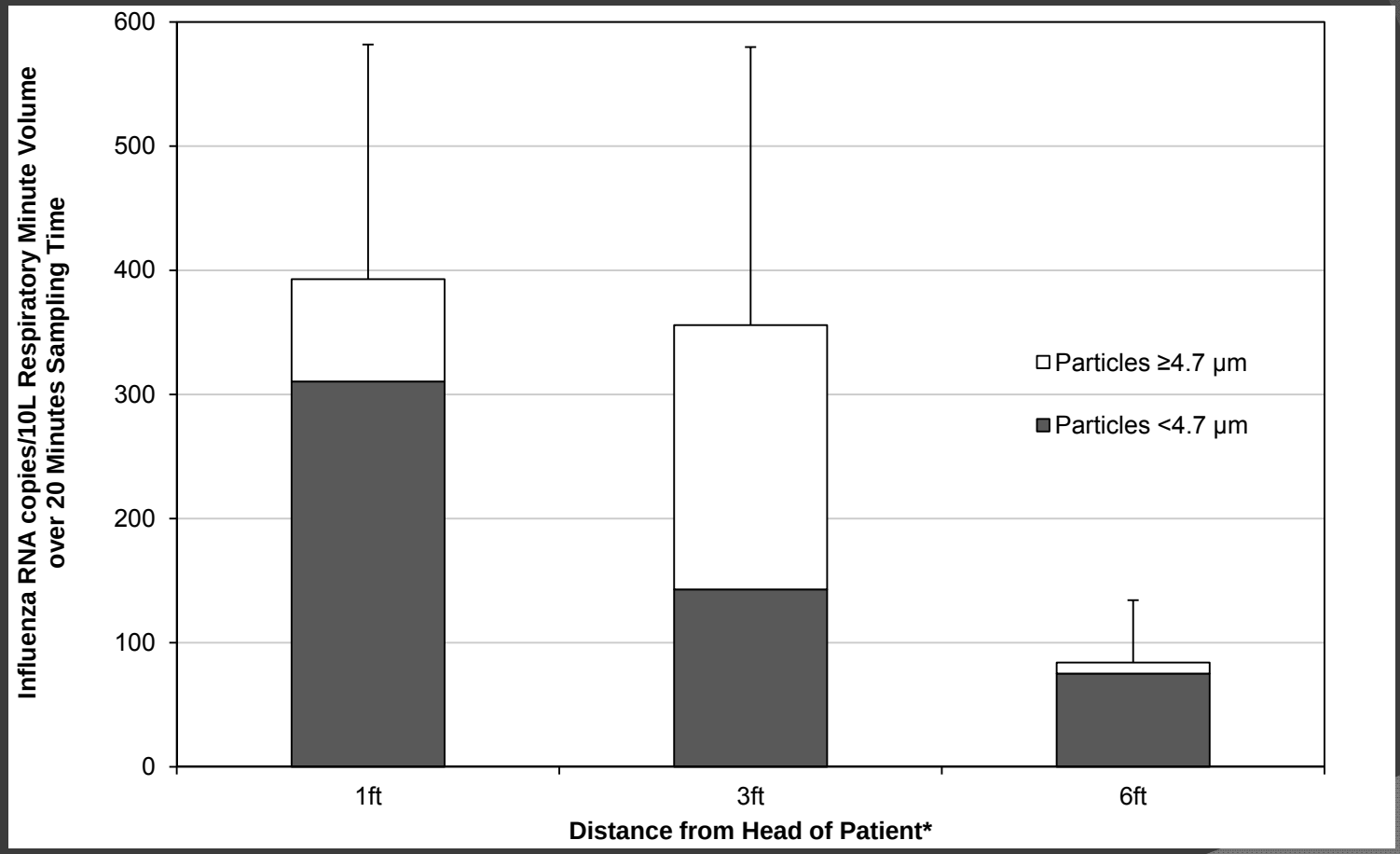
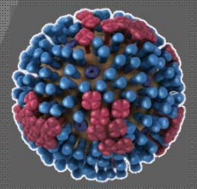
Spatial Distribution of Average Influenza Aerosol Concentrations in Patient Rooms



*Number of emitters exceeding the low or high HID_{50} by distance:
Low HID_{50} (>90 RNA copies): 1ft – 13 (50%) out of 26 subjects; 3ft – 11(42%); 6ft – 9(35%)
High HID_{50} (>1,950 RNA copies): 1ft – 3 (12%) out of 26 subjects; 3ft – 2(8%); 6ft – 1(4%)
(one emitter can exceed the HID_{50} at more than one distance)



Limitations

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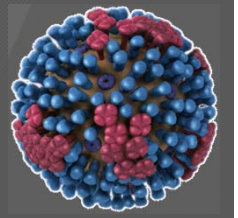
- Study of exposure to influenza aerosols NOT transmission
- PCR versus virus culture
- Cross-sectional design – dispersal routes over illness progression?
- Convenience samples using CDC ILI criteria/rapid test:
  - Exclusion of asymptomatic emitters?
  - Over-enrollment of patients with high amounts of influenza
- No differentiation of larger particle sizes (>7um)
- Potential of Influenza aerosols generated by other sources (e.g. HCPs):
  - Type match of swab results with air samples
  - Mandatory vaccination campaign
  - Shedding associated with influenza emission



Summary of Key Findings

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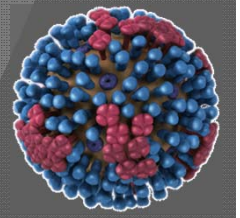
- 43% of influenza-infected patients released virus into room air
- Influenza virus was detected up to 6ft from the patients
- Virus was predominantly contained in small particles <4.7μm
- All tests done during non-aerosol-generating patient care activities
- Dispersal linked to high nasopharyngeal viral load, severity of illness, and impact on daily life
- Five of the 26 emitters released influenza in exceptionally high concentrations



Acknowledgements

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  - Michael Bell, MD
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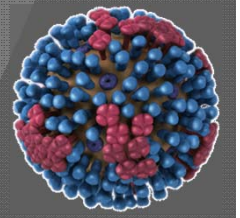
- Co-investigators:
  - Timothy Peters, MD
  - John Stehle, PhD
  - Iris Leng, MD PhD
  - Katrina Swett, MS

- Publications:

  - Bischoff WE, Swett K, Leng I, Peters TR. Exposure to Influenza Aerosols during Routine Care. J Infect Dis. 2013;207:1037-46
  - Bischoff WE, Reid T, Russell GB, Peters TR. Trans-ocular Entry of Seasonal Influenza Attenuated Virus Aerosols and the Efficacy of N95 Respirators, Surgical Masks, and Eye Protection in Human Subjects. J Infect Dis. 2011;204:193-9



Thanks: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